

composite (NMHC+NO<sub>x</sub>) and optional composite CO standards shall be computed by the following formulas.

$$(i) Y_{WSFTP} = 0.72(Y_{FTP}) + 0.28(Y_{US06})$$

Where:

(A)  $Y_{WSFTP}$  = Mass emissions per mile for a particular pollutant weighted in terms of the contributions from the FTP and US06 schedules. Values of  $Y_{WSFTP}$  are obtained for each of the exhaust emissions of NMHC, NO<sub>x</sub> and CO.

(B)  $Y_{FTP}$  = Weighted mass emissions per mile (Ywm) based on the measured driving distance of the FTP test schedule.

(C)(1)  $Y_{US06}$  = Calculated mass emissions per mile based on the measured driving distance of the US06 test schedule; or,

(2) In the case of a 2-phase US06 test run according to the provisions of § 86.159–08(f)(2) and part 600 of this chapter:

$Y_{US06}$  = Calculated mass emissions per mile, using the summed mass emissions of the “US06 City” phase and the “US06 Highway” phase, based on the measured driving distance of the US06 test schedule. The “US06 City” phase shall be sampled during seconds 0–130 and from 495 seconds until five seconds after the engine stops running (e.g. 602 or 603 seconds) of the US06 driving schedule. The “US06 Highway” phase shall be sampled during seconds 130–495 of the US06 driving schedule),

$$(ii) \text{ Composite (NMHC+NO}_x\text{) } = Y_{WSFTP}(\text{NMHC}) + Y_{WSFTP}(\text{NO}_x)$$

Where:

(A)  $Y_{WSFTP}(\text{NMHC})$  = results of paragraph (c)(2)(i) of this section for NMHC.

(B)  $Y_{WSFTP}(\text{NO}_x)$  = results of paragraph (c)(2)(i) of this section for NO<sub>x</sub>.

(d) The NO<sub>x</sub> humidity correction factor for adjusting NO<sub>x</sub> test results to the environmental test cell air conditioning ambient condition of 100 grains of water/pound of dry air is:

$$K_H(100) = 0.8825/[1 - 0.0047(H - 75)]$$

Where:

H = measured test humidity in grains of water/pound of dry air.

[71 FR 77922, Dec. 27, 2006, as amended at 74 FR 61548, Nov. 25, 2009]

#### § 86.165–12 Air conditioning idle test procedure.

(a) *Applicability.* This section describes procedures for determining air conditioning-related CO<sub>2</sub> emissions from light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles. The results of this test are used to qualify for air conditioning efficiency CO<sub>2</sub> credits according to § 86.1866–12(c).

(b) *Overview.* The test consists of a brief period to stabilize the vehicle at idle, followed by a ten-minute period at idle when CO<sub>2</sub> emissions are measured without any air conditioning systems operating, followed by a ten-minute period at idle when CO<sub>2</sub> emissions are measured with the air conditioning system operating. This test is designed to determine the air conditioning-related CO<sub>2</sub> emission value, in grams per minute. If engine stalling occurs during cycle operation, follow the provisions of § 86.136–90 to restart the test. Measurement instruments must meet the specifications described in this subpart.

(c) *Test cell ambient conditions.* (1) Ambient humidity within the test cell during all phases of the test sequence shall be controlled to an average of  $50 \pm 5$  grains of water/pound of dry air.

(2) Ambient air temperature within the test cell during all phases of the test sequence shall be controlled to  $75 \pm 2$  °F on average and  $75 \pm 5$  °F as an instantaneous measurement. Air temperature shall be recorded continuously at a minimum of 30 second intervals.

(d) *Test sequence.* (1) Connect the vehicle exhaust system to the raw sampling location or dilution stage according to the provisions of this subpart. For dilution systems, dilute the exhaust as described in this subpart. Continuous sampling systems must meet the specifications provided in this subpart.

(2) Test the vehicle in a fully warmed-up condition. If the vehicle has soaked for two hours or less since the last exhaust test element, preconditioning may consist of a 505 Cycle, 866 Cycle, US06, or SC03, as these terms are defined in § 86.1803–01, or a highway fuel economy test procedure, as defined in § 600.002–08 of this chapter. For soak

periods longer than two hours, precondition the vehicle using one full Urban Dynamometer Driving Schedule. Ensure that the vehicle has stabilized at test cell ambient conditions such that the vehicle interior temperature is not substantially different from the external test cell temperature. Windows may be opened during preconditioning to achieve this stabilization.

(3) Immediately after the preconditioning, turn off any cooling fans, if present, close the vehicle's hood, fully close all the vehicle's windows, ensure that all the vehicle's air conditioning systems are set to full off, start the CO<sub>2</sub> sampling system, and then idle the vehicle for not less than 1 minute and not more than 5 minutes to achieve normal and stable idle operation.

(4) Measure and record the continuous CO<sub>2</sub> concentration for 600 seconds. Measure the CO<sub>2</sub> concentration continuously using raw or dilute sampling procedures. Multiply this concentration by the continuous (raw or dilute) flow rate at the emission sampling location to determine the CO<sub>2</sub> flow rate. Calculate the CO<sub>2</sub> cumulative flow rate continuously over the test interval. This cumulative value is the total mass of the emitted CO<sub>2</sub>. Alternatively, CO<sub>2</sub> may be measured and recorded using a constant velocity sampling system as described in §§ 86.106-96(a)(2) and 86.109.

(5) Within 60 seconds after completing the measurement described in paragraph (d)(4) of this section, turn on the vehicle's air conditioning system. Set automatic air conditioning systems to a temperature 9 °F (5 °C) below the ambient temperature of the test cell. Set manual air conditioning systems to maximum cooling with recirculation turned off, except that recirculation shall be enabled if the air conditioning system automatically defaults to a recirculation mode when set to maximum cooling. Continue idling the vehicle while measuring and recording the continuous CO<sub>2</sub> concentration for 600 seconds as described in paragraph (d)(4) of this section. Air conditioning systems with automatic temperature controls are finished with the test after this 600 second idle period. Manually controlled air conditioning systems must complete one ad-

ditional idle period as described in paragraph (d)(6) of this section.

(6) This paragraph (d)(6) applies only to manually controlled air conditioning systems. Within 60 seconds after completing the measurement described in paragraph (d)(5) of this section, leave the vehicle's air conditioning system on and set as described in paragraph (d)(5) of this section but set the fan speed to the lowest setting that continues to provide air flow. Recirculation shall be turned off except that if the system defaults to a recirculation mode when set to maximum cooling and maintains recirculation with the low fan speed, then recirculation shall continue to be enabled. After the fan speed has been set, continue idling the vehicle while measuring and recording the continuous CO<sub>2</sub> concentration for a total of 600 seconds as described in paragraph (d)(4) of this section.

(e) *Calculations.* (1) For the measurement with no air conditioning operation, calculate the CO<sub>2</sub> emissions (in grams per minute) by dividing the total mass of CO<sub>2</sub> from paragraph (d)(4) of this section by 10.0 (the duration in minutes for which CO<sub>2</sub> is measured). Round this result to the nearest tenth of a gram per minute.

(2)(i) For the measurement with air conditioning in operation for automatic air conditioning systems, calculate the CO<sub>2</sub> emissions (in grams per minute) by dividing the total mass of CO<sub>2</sub> from paragraph (d)(5) of this section by 10.0. Round this result to the nearest tenth of a gram per minute.

(ii) For the measurement with air conditioning in operation for manually controlled air conditioning systems, calculate the CO<sub>2</sub> emissions (in grams per minute) by summing the total mass of CO<sub>2</sub> from paragraphs (d)(5) and (d)(6) of this section and dividing by 20.0. Round this result to the nearest tenth of a gram per minute.

(3) Calculate the increased CO<sub>2</sub> emissions due to air conditioning (in grams per minute) by subtracting the results of paragraph (e)(1) of this section from the results of paragraph (e)(2)(i) or (ii) of this section, whichever is applicable.

(f) The Administrator may prescribe procedures other than those in this section for air conditioning systems and/

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or vehicles that may not be susceptible to satisfactory testing by the procedures and methods in this section. For example, the Administrator may prescribe alternative air conditioning system settings for systems with controls that are not able to meet the requirements in this section.

[75 FR 25680, May 7, 2010, as amended at 76 FR 39521, July 6, 2011]

### § 86.166–12 Method for calculating emissions due to air conditioning leakage.

This section describes procedures used to determine a refrigerant leakage rate in grams per year from vehicle-based air conditioning units. The results of this test are used to determine air conditioning leakage credits according to § 86.1866–12(b).

(a) *Emission totals.* Calculate an annual rate of refrigerant leakage from an air conditioning system using the following equation:

$$\text{Grams/YR}_{\text{TOT}} = \text{Grams/YR}_{\text{RP}} + \text{Grams/YR}_{\text{SP}} + \text{Grams/YR}_{\text{FH}} + \text{Grams/YR}_{\text{MC}} + \text{Grams/YR}_{\text{C}}$$

Where:

Grams/YR<sub>TOT</sub> = Total air conditioning system emission rate in grams per year and rounded to the nearest tenth of a gram per year.

Grams/YR<sub>RP</sub> = Emission rate for rigid pipe connections as described in paragraph (b) of this section.

Grams/YR<sub>SP</sub> = Emission rate for service ports and refrigerant control devices as described in paragraph (c) of this section.

Grams/YR<sub>FH</sub> = Emission rate for flexible hoses as described in paragraph (d) of this section.

Grams/YR<sub>MC</sub> = Emission rate for heat exchangers, mufflers, receiver/driers, and accumulators as described in paragraph (e) of this section.

Grams/YR<sub>C</sub> = Emission rate for compressors as described in paragraph (f) of this section.

(b) *Rigid pipe connections.* Determine the grams per year emission rate for rigid pipe connections using the following equation:

$$\text{Grams/YR}_{\text{RP}} = 0.00522 \times [(125 \times \text{SO}) + (75 \times \text{SCO}) + (50 \times \text{MO}) + (10 \times \text{SW}) + (5 \times \text{SWO}) + (\text{MG})]$$

Where:

Grams/YR<sub>RP</sub> = Total emission rate for rigid pipe connections in grams per year.

SO = The number of single O-ring connections.

SCO = The number of single captured O-ring connections.

MO = The number of multiple O-ring connections.

SW = The number of seal washer connections.

SWO = The number of seal washer with O-ring connections.

MG = The number of metal gasket connections.

(c) *Service ports and refrigerant control devices.* Determine the grams per year emission rate for service ports and refrigerant control devices using the following equation:

$$\text{Grams/YR}_{\text{SP}} = 0.522 \times [(0.3 \times \text{HSSP}) + (0.2 \times \text{LSSP}) + (0.2 \times \text{STV}) + (0.2 \times \text{TXV})]$$

Where:

Grams/YR<sub>SP</sub> = The emission rate for service ports and refrigerant control devices, in grams per year.

HSSP = The number of high side service ports.

LSSP = The number of low side service ports.

STV = The total number of switches, transducers, and pressure relief valves.

TXV = The number of refrigerant control devices.

(d) *Flexible hoses.* Determine the permeation emission rate in grams per year for each segment of flexible hose using the following equation, and then sum the values for all hoses in the system to calculate a total flexible hose emission rate for the system. Hose end connections shall be included in the calculations in paragraph (b) of this section.

$$\text{Grams/YR}_{\text{FH}} = 0.00522 \times (3.14159 \times \text{ID} \times \text{L} \times \text{ER})$$

Where:

Grams/YR<sub>FH</sub> = Emission rate for a segment of flexible hose in grams per year.

ID = Inner diameter of hose, in millimeters.

L = Length of hose, in millimeters.

ER = Emission rate per unit internal surface area of the hose, in g/mm<sup>2</sup>. Select the appropriate value for ER from the following table: